

S/N 10/743,247
Inventor: Tan et al.
Reply to the Office action dated August 04, 2005

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AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listing, of claims in the application:

Listing of claims:

In the Claims

This listing of claims will replace all prior versions and listing of claims in the application

- 1 1. (CURRENTLY AMENDED) A method for forming an amorphous shallow implant
2 region that getters defects from a pocket implantation; comprising:
 - 3 a) providing a gate structure, on a substrate comprised with a first conductivity type
4 dopant; said substrate comprised of an upper crystalline section;
 - 5 b) performing a pocket amorphizing implantation procedure to implant ions of a
6 ~~second~~ first conductivity type to form a pocket implant region adjacent
7 to said gate structure, and an amorphous pocket region;
 - 8 (1) said amorphous pocket region is formed at a first depth below the
9 substrate surface;
 - 10 c) performing a shallow amorphizing implant to form an amorphous shallow
11 implant region;
 - 12 (1) said amorphous shallow implant region being formed at a second
13 depth above said amorphous pocket region;
 - 14 d) performing an anneal procedure to recrystallize the amorphous shallow implant
15 region and said amorphous pocket region, whereby said amorphous
16 shallow implant region reduces defects formed by the pocket
17 amorphizing implant.
- 18 2. (ORIGINAL) The method of claim 1 wherein the anneal procedure is comprised of a
19 first soak step and a second spike step.

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- 1 3.(ORIGINAL) The method of claim 1 wherein said amorphous pocket region is formed
2 at a depth between 40 and 100 nm; said amorphous pocket region has a thickness
3 between 10 and 20 nm;
4 and the substrate above the amorphous pocket region remains crystalline.
- 5 4.(ORIGINAL) The method of claim 1 wherein the pocket amorphizing implantation
6 comprises implanting Sb or In species at an energy between 115 and 150 keV using a
7 quad implant at a 45 degree angle to form a pocket implant to a depth between 40 and
8 100 nm.
- 9 5.(CURRENTLY AMENDED) The method of claim 1 wherein the shallow amorphizing
10 implant comprises: implanting As, Si, or Ge or N species at a dose between $5E13\text{cm}^{-2}$
11 and $7E14\text{cm}^{-2}$ and at an energy between 5 and 10 keV, and preferably at a 7 degree
12 and a quad twist; said first conductivity type is N-type and said second conductivity
13 type is p-type.
- 14 6.(ORIGINAL) The method of claim 1 wherein said amorphous shallow implant region
15 is formed at a minimum depth of about 8 nm and a maximum depth of 20 nm below
16 the substrate surface; said amorphous shallow implant region has a thickness between 5
17 and 10 nm.
- 18 7.(ORIGINAL) The method of claim 1 wherein the anneal procedure comprises: (1) a
19 soak step at a temperature between 600 and 800 °C for a time between 10 and 30
20 seconds and (2) a spike step where the temperature ramps up to a peak temperature
21 between 1000 and 1100 °C and a ramp down from said peak temperature to a
22 temperature below 800 °C; said ramp up and ramp down have a rate between 200 and
23 300 degree °C per minute.
- 24
- 25 8. (CURRENTLY AMENDED) A method for forming an amorphous shallow implant
26 region that getters defects from a pocket implantation; comprising:

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- 1 a) providing a gate structure, on a substrate comprised with a first conductivity type
2 dopant; said substrate comprised of an upper crystalline section;
3 b) performing a pocket amorphizing implantation procedure to implant ions of a
4 ~~second~~ first conductivity type to form a pocket implant region adjacent
5 to said gate structure, and an amorphous pocket region;
6 (1) said amorphous pocket region is formed at a first depth below the
7 substrate surface;
8 c) performing a shallow amorphizing implant to form an amorphous shallow
9 implant region; the shallow amorphizing implant comprises:
10 implanting ions of Si, As, or Ge species;
11 (1) said amorphous shallow implant region being formed at a second
12 depth above said amorphous pocket region;
13 d) performing a SDE implant to form SDE regions of a second conductivity type
14 using said gate structure as a mask;
15 e) performing a source/drain implant procedure to form deep source/drain regions;
16 f) performing an anneal procedure to recrystallize the amorphous shallow implant
17 region and said amorphous pocket region, whereby said amorphous
18 shallow implant region reduces defects formed by the pocket
19 amorphizing implant.
20 9.(ORIGINAL) The method of claim 8 wherein the anneal procedure is comprised of a
21 first soak step and a second spike step.
22 10. (ORIGINAL) The method of claim 8 wherein said amorphous pocket region is
23 formed at a depth between 40 and 100 nm; said amorphous pocket region has a
24 thickness between 10 and 20 nm;
25 and the substrate above the amorphous pocket region remains crystalline.
26

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- 1 11. (ORIGINAL) The method of claim 8 wherein the pocket amorphizing implantation
2 comprises implanting Sb or In species at an energy between 115 and 150 keV using a
3 quad implant at a 45 degree angle to form a pocket implant to a depth between 40 and
4 100 nm.
- 5 12.(CURRENTLY AMENDED) The method of claim 8 wherein the shallow
6 amorphizing implant comprises: implanting As, Si, or Ge or N species at a dose
7 between $5 \times 10^{13} \text{ cm}^{-2}$ and $7 \times 10^{14} \text{ cm}^{-2}$ and at an energy between 5 and 10 keV, and
8 preferably at a 7 degree and a quad twist.
- 9 13. (ORIGINAL) The method of claim 8 wherein said amorphous shallow implant
10 region is formed at a minimum depth of about 8 nm and a maximum depth of 20 nm
11 below the substrate surface; said amorphous shallow implant region has a thickness
12 between 5 and 10 nm.
- 13 14. (ORIGINAL) The method of claim 8 wherein said amorphous shallow implant region
14 has a thickness between 5 and 10 nm.
- 15 15.(ORIGINAL) The method of claim 8 wherein the S/D implant procedure comprises:
16 implanting As ions at a dose of between 5×10^{13} and 7×10^{14} atoms/sq-cm; an energy
17 between 5 and 10 keV and a maximum depth between 30 and 50 nm.
- 18 16. (ORIGINAL) The method of claim 8 wherein the anneal procedure comprises: (1)
19 a soak step at a temperature between 600 and 800 °C for a time between 10 and 30
20 seconds and (2) a spike step where the temperature ramps up to a peak temperature
21 between 1000 and 1100 °C and a ramp down from said peak temperature to a
22 temperature below 800 °C; said ramp up and ramp down have a rate between 200 and
23 300 degree °C per minute.
- 24
- 25 17. (Currently Amended) A method of for a pocket implant comprising:
26 a) providing a gate structure on a semiconductor substrate comprised with a first
27 conductivity type dopant;

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- 1 b) performing a pocket amorphizing implantation procedure to implant ions of a
2 first conductivity type to form a pocket implant region adjacent to said
3 gate structure, an amorphous pocket region and pocket interstitials
4 under the amorphous pocket region;
- 5 c) performing a shallow amorphizing implant to form an amorphous shallow
6 implant region and shallow implant interstitials; the amorphous
7 shallow implant region being formed at a second depth above said
8 amorphous pocket region;
9 the substrate above the amorphous shallow implant
10 region remains crystalline;
- 11 (1) said amorphous shallow implant region is formed at a minimum
12 depth of about 8 nm and a maximum depth of 20 nm below the
13 substrate surface; said amorphous shallow implant region has a
14 thickness between 5 and 10 nm;
- 15
- 16 d) performing a SDE implant to form SDE regions of a second conductivity type, in
17 an area of said semiconductor substrate not covered by said gate
18 structure, with said SDE regions located in a top portion of said pocket
19 region;
- 20 e) forming spacers on the sidewalls of the gate structure;
- 21 f) performing a S/D implant procedure to form Deep S/D regions;
- 22 g) performing an anneal procedure comprised of a first soak step and a second spike
23 step to recrystallize the amorphous shallow implant region and said
24 amorphous pocket region; whereby said shallow amorphous implant
25 region reduces the defects from the pocket implantation;

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- 1 (1) the anneal procedure comprises (1) a soak step at a temperature
2 between 600 and 800 °C for a time between 10 and 30 seconds and
3 (2) a spike step where the temperature ramps up to a peak
4 temperature between 1000 and 1100 °C and a ramp down from said
5 peak temperature to a temperature below 800 °C; said ramp up and
6 ramp down have a rate between 200 and 300 degree° C per minute.

7
8 18. (ORIGINAL) The method of claim 17 wherein the pocket amorphizing implantation
9 comprises implanting Sb or In species at an Energy between 115-150 keV using a
10 quad implant at a 45 degree angle to form a pocket implant region to a depth between
11 40 and 100 nm.

19. (ORIGINAL) The method of claim 17 wherein said amorphous pocket region is formed at a
depth range between 40 and 100 nm; said amorphous pocket region has a thickness between
10 and 20 nm; the substrate above the amorphous pocket region remains crystalline.

20. (Currently Amended) The method of claim 17 wherein the shallow amorphizing implant
comprises: implanting As, Si, or Ge species at a dose greater than $5 \times 10^{13} \text{cm}^{-2}$ and at an
energy between 5 and 10 keV, and preferably at a 7 degree and a quad twist.

21. (New) The method of claim 1 wherein said amorphous shallow implant region is not a halo
region.

22. (NEW) The method of claim 1 wherein said wherein the shallow amorphizing implant
comprises: implanting As, Si, or Ge species; said first conductivity type is p-type and said
second conductivity type is n-type.

23. (NEW) The method of claim 1 wherein said wherein the shallow amorphizing implant
comprises: implanting Si, or Ge species.

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24. (NEW) The method of claim 17 wherein said wherein the shallow amorphizing implant comprises: implanting Si, Ge or As species.